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The transfer of petrol on to clothing and shoes while pouring petrol around a room

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Abstract

This study was aimed at measuring the approximate amount of petrol transferred on to the clothing and shoes of a person during the action of pouring petrol around a room. Two different heights of pouring and two different types of floor surface (carpet and concrete) were investigated. Results show that for all the combinations examined petrol was always transferred to the shoes and often transferred to the upper and lower clothing. This information illustrates the necessity of analysing the clothing and particularly the shoes of any suspected arsonists for the presence of hydrocarbon fuels.

Keywords: Petrol; Clothing; Hydrocarbon fuels; Accelerants; Arson

1. Introduction

The question of 'how much petrol would be transferred on to the clothing and shoes of an arsonist while he spreads petrol around a room' was posed to an analyst from our laboratory during a court trial. A survey of the literature revealed a lack of information about the amount of petrol or other accelerants transferred to clothing and shoes during the act of spreading an accelerant around a room. Folkman et al. [1] have described the evaporation of various accelerants on clothing and shoes. However, as far as we are

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aware, nobody has quantified the amount of accelerants transferred to the clothing and shoes worn by an arsonist while spreading a flammable liquid around a room.

It could be argued that the finding of accelerant residues on a person's clothing is due to legitimate contact, such as while filling a car with petrol. Folkman [1] examined the clothing of a service station attendant at the end of his shift. No petrol residues were detected. The question of transfer by legitimate contact is not examined here.

This work was designed to answer the following questions. (i) How much accelerant is transferred to the upper clothing, the lower clothing and the shoes? and (ii) how do different pouring actions affect this amount?

2. Experimental

2.1. Materials

Petrol from a local gas station was purchased and used in 2 litre lots from a standard petrol can. Distilled isopentane was used to extract the distillate.

Freshly cleaned clothing and shoes donated from various staff members were used. T-shirts or sweatshirts were used for the upper clothing, jeans for the lower clothing and sneakers for the shoes.

2.2. Equipment

Steam distillation was used for the recovery of any petrol transferred on to the clothing and shoes. The steam distillation set up is a variation of the classical steam distillation set up. It involves passing steam, under pressure, through the substrate, condensing the steam and collecting the distillate. The distillate is then extracted with isopentane. The extract is evaporated down to concentrate any accelerants present. This method has the ability to approximately quantify the amount of petrol recovered.

Previous trials have shown that this variation of the steam distillation technique is capable of detecting minimum volumes of petrol in the order of 10 μl.

The evaporated extracts were analysed on a Hewlett Packard 5890 Series II Plus with a 30 m HP-5 column and equipped with a flame ionisation detector. The GC conditions used were; hydrogen carrier gas, with a flow rate of 30 ml/min, injection volume 1 μl with split ratio of 50:1, temperature program from 40°C to 100°C @ 5°C/min, then to 260°C @ 10°C/min, then hold at 260°C for 2 min, detector temperature 260°C.

Identification of petrol in the resulting chromatograms was done by noting (via overlay) the presence of the cluster of C_4-substituted benzenes between 8.4 and 9.4 min and the durene peaks at 10.2 and 10.3 min (Fig. 1). A trace of petrol was defined as the presence of the durene peaks but insufficient detail above the background noise to distinguish the C4-substituted benzenes. Such a chromatogram in normal casework would be defined as negative, but for the purpose of this study the indication of a trace of petrol was noted.

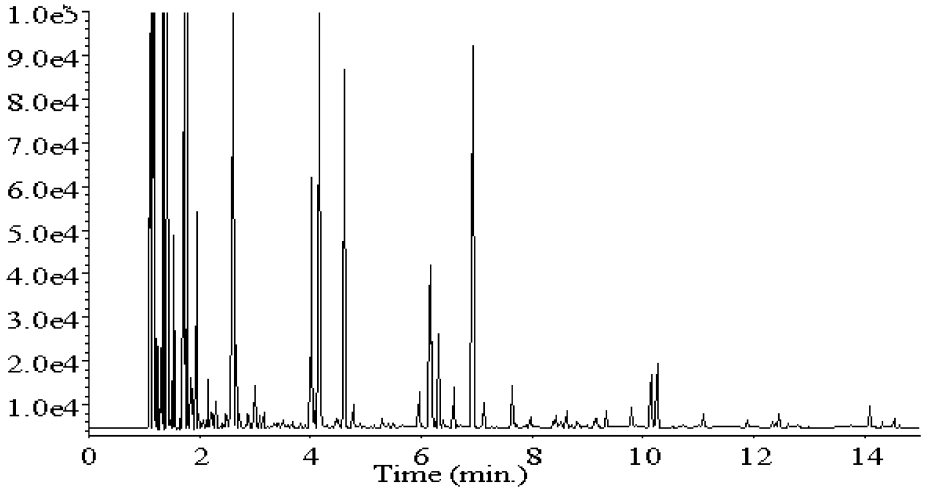

Fig. 1. Petrol standard.

3. Results and discussion

Petrol was chosen as the accelerant examined as it is by far the most commonly encountered flammable liquid in casework. The subsequent evaporation rates for petrol on clothing have been documented and are, therefore, directly applicable to the quantities recovered.

Five different pouring scenarios were investigated. Firstly, pouring petrol on to a concrete floor in an enclosed area of approximately 9 m^2 was investigated. Petrol was poured from both knee height and hip height. These two pouring statures were repeated but by pouring the petrol on to a piece of carpet of approximately 6 m^2. Finally, the action of actively splashing the petrol on to concrete walls in an enclosed area was investigated. A petrol can containing two litres of petrol was used for each pouring scenario.

The ‘arsonist’ wore either a t-shirt or sweatshirt, a pair of jeans and a pair of sneakers for each trial. These articles of clothing and shoes were chosen to reflect the common types of garments submitted for casework analysis. The clothing and sneakers were removed immediately after each trial and packaged in nylon bags to prevent evaporation of any transferred petrol.

Figs. 2 and 3 show the GC traces obtained for the upper clothing, the lower clothing and the shoes for two of the pouring scenarios.

Table 1 shows the amount of petrol detected on the upper clothing (either t-shirt or sweatshirt), the jeans and the sneakers. The reader should be aware that each trial was carried out only once and that it is expected that different pouring actions by different people would result in differing amounts of petrol being transferred. However, we believe the results give an indication of the volume of petrol that could be expected to be transferred.

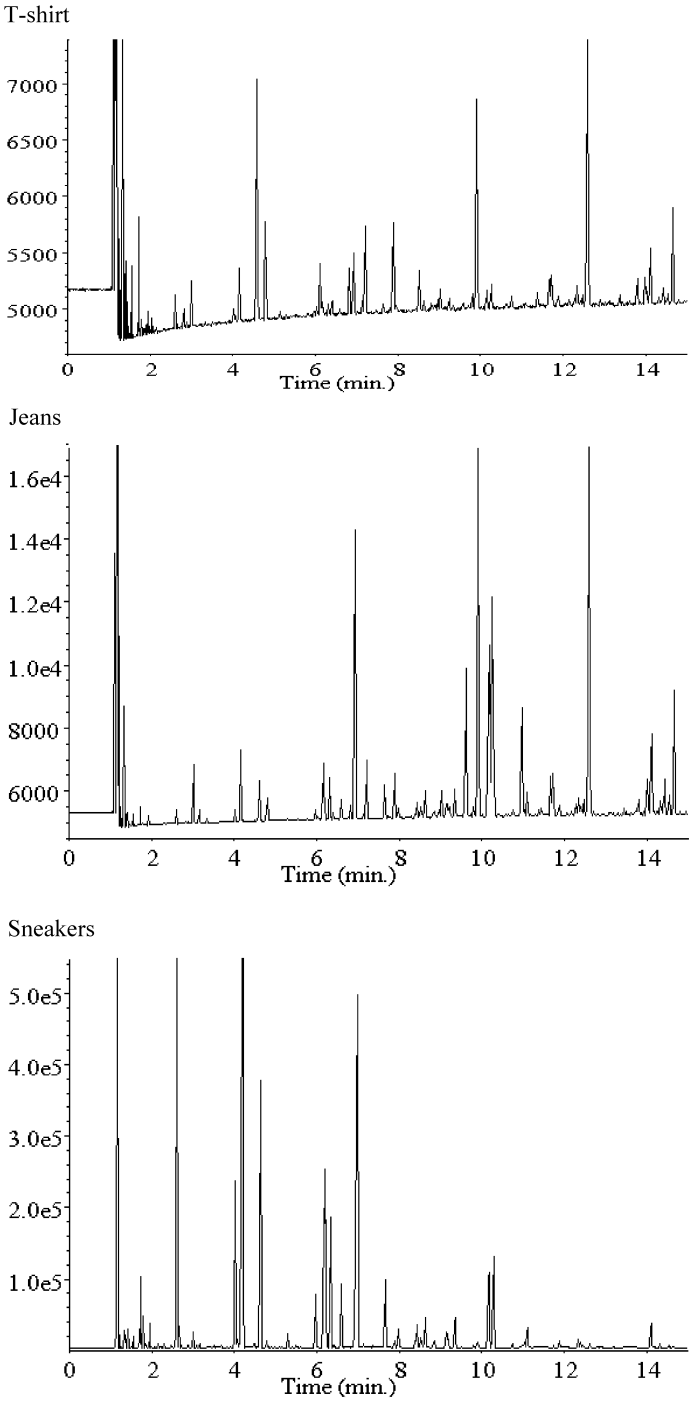

Fig. 2. Petrol poured on to carpet from hip height.

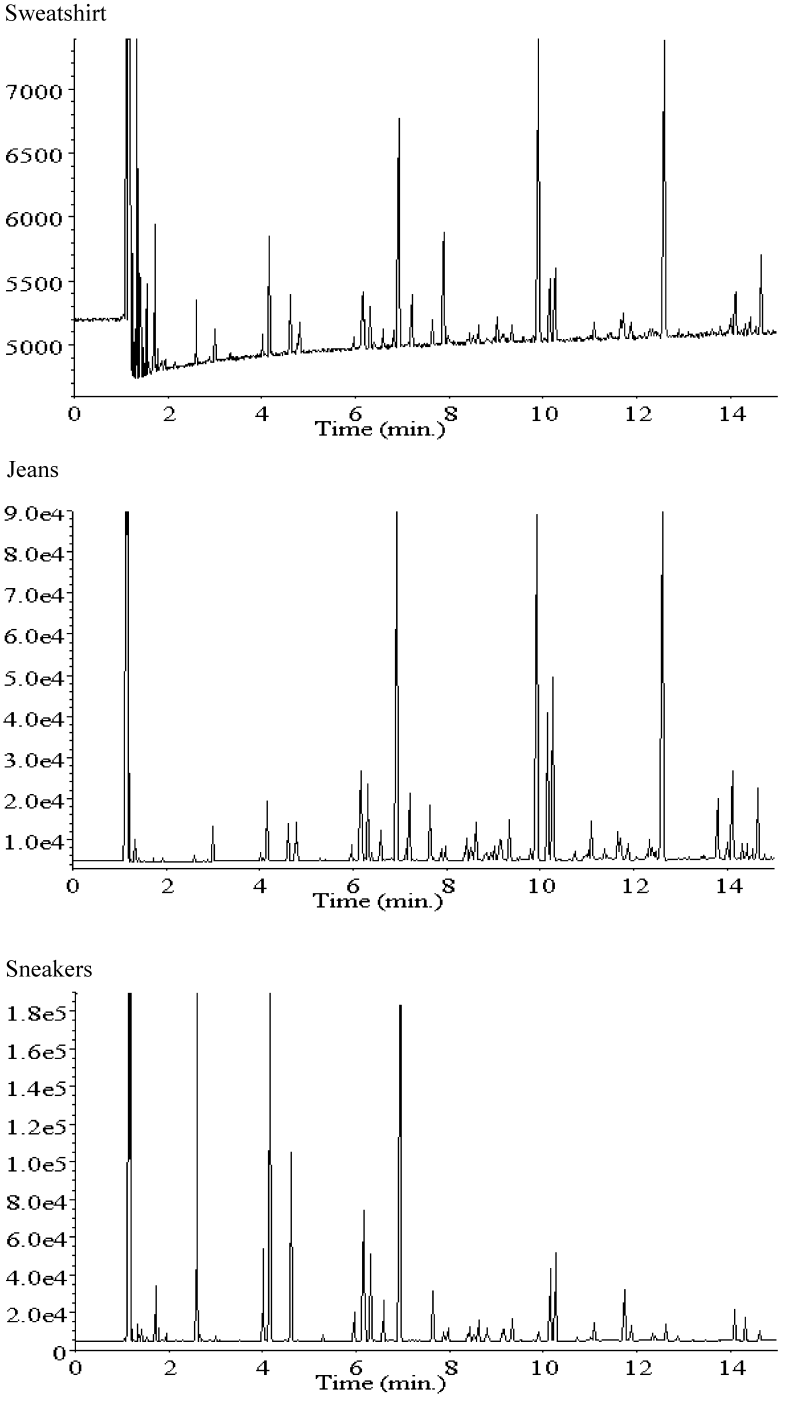

Fig. 3. Petrol splashed on to concrete walls.

Table 1
Amount of petrol transferred to the clothing and sneakers (ml)

Surface	Pouring action	T-shirt	Sweatshirt	Jeans	Sneakers
Concrete	Knee height	0	–	0	11
Concrete	Hip height	–	0.08	0.4	25
Carpet	Knee height	–	trace	0.1	0.05
Carpet	Hip height	0.02	–	3	30
Concrete	Splashing walls	–	0.06	5	7

The knee height pouring action on to a concrete floor showed a detectable transfer of petrol to only the sneakers (11 ml). No petrol was detected on either the upper or lower clothing. Whereas, for the knee height pouring action on the carpet floor a trace amount of petrol was found on the sweatshirt, 0.1 ml on the jeans and 0.05 ml on the sneakers. The differences seen in the amount transferred to the upper clothing may be accounted for by the concrete floor trial using a t-shirt (with short sleeves) whereas the carpet trial used a sweatshirt (with long sleeves). The large differences seen between the amount of petrol detected on the sneakers may be due to a splash feature of the concrete surface compared to the absorbing nature of the carpet or a slightly different pouring action used.

The hip height pouring trials for both the concrete and the carpet floors show a marked increase in the amount of petrol transferred to the clothing and sneakers compared to the knee height trials. For both trials petrol was easily detected on the upper and lower clothing and on the sneakers.

The splashing of the concrete walls trial showed more petrol on the jeans than any of the previous trials. This is presumably due to the action of splashing petrol around the room and against an upright wall.

This study has made no attempt to take into account such variables as the effect of different types of clothing or the rate of evaporation of the accelerant from the clothing and shoes. It is expected that some fabrics will retain flammable liquids more than others. The amount of exposure to heat from any fire subsequently set by the arsonist is also expected to have some effect on the rate of evaporation of any transferred accelerants.

4. Conclusion

These trials have attempted to provide an answer to the question: how much petrol is transferred on to the clothing and shoes of a person when they spread an accelerant around a room? As shown, it is highly likely that petrol will be transferred on to the shoes. It is also probable that some petrol will be transferred on to the clothing, with the lower clothing being more likely to come into contact with the accelerant than the upper clothing. It is therefore recommended that the clothing and shoes from any suspects are seized as soon as possible.

Acknowledgements

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References

[1] T.E. Folkman, A.M. Kuehl, R.I. Groves, A.D. Beveridge, Evaporation rates of gasoline from shoes, clothing, wood and carpet materials and kerosene from shoes and clothing, Canadian Society Forensic Science Journal 23 (2&3) (1990) 49–59.